Quantifying uncertainty in Transient Climate sensitivity subject to uncertainty in forcing and natural variability using a non-Gaussian filter

Aneesh Subramanian[a], Ibrahim Hoteit[b], Bruce Cornuelle[a] and Kyle Armour[c]

[a] *Scripps Institution of Oceanography, UCSD, U.S.A., acsubram@ucsd.edu,* [b] Earth Sciences and Engineering, *KAUST, U.S.A.,* [c] Earth and Planetary Sciences, MIT, *U.S.A.*

Uncertainty in future climate change presents a key challenge for various socio-economic policies and planning decisions. Estimates of climate sensitivity are typically characterized by highly asymmetric probability density functions (pdfs). The reasons are well known, but the situation leaves open an uncomfortably large possibility that climate sensitivity might exceed the current estimates of uncertainty. We address the importance of considering non-Gaussian distributions in quantifying uncertainty on estimates of transient climate sensitivity (TCS) of the globally averaged surface temperature, including both uncertainty in past forcing and internal variability in the climate record using a nonlinear particle filter. We extend previously done analysis of this uncertainty to non-Gaussian systems and discuss the implications of important effects such as intermittency and granularity of the climate system. We make these estimates using a nonlinear particle filter coupled to a stochastic, global energy balance model, using the filter and observations to constrain the model parameters. We compare these uncertainties to those obtained from a Gaussian analyses based ensemble Kalman filter estimates. We verify that model and filters are able to emulate the evolution of the global mean temperature derived from comprehensive, state-of-the-art atmosphere-ocean general circulation models and to accurately predict the TCS of the model, and then apply the methodology to observed temperature and forcing records of the 20th century.